Indian woods; an herbarium, a chemical laboratory, and a meteorological observatory; while the forests of three districts are attached to the School as a training-ground, in which the young students may learn, by personal and actual experience, the conduct of forest operations in the field. The students are usually selected in the different provinces by the Conservators of Forests, and are generally young officers who have seen already some preliminary service. Several have been deputed by the chief native States, such as Mysore and Baroda, and this shows the spread that an enlightened forest policy is making in the country. There are, besides, a number of independent students, who study in the hope of obtaining appointments if successful, either in the British territory or in the native States.

Two courses of study are carried on at the School, the higher in English, leading up to the ranger's certificate, which qualifies the students who succeed in obtaining it for the appointment as "Forest Ranger," on salaries rising from Rs. 600 to Rs. 3000 yearly; the lower, in Hindustani, leading to the forester's certificate, which qualifies the holder for appointments of from Rs. 240 to Rs. 480 per annum. The ranger's course lasts twenty-one months, of which eight are spent in theoretical instruction, and the rest in practical work in the field. The subjects taught are forestry, botany, the elements of zoology, chemistry, physics, geology, mathematics, and surveying, with elementary engineering, such as road-making and the construction of forest export works, and forest law. The forester's course lasts sixteen months, four in theoretical study, and the rest in the field, and the subjects taught are elementary forestry and botany, mathematics, surveying and plan-drawing, and departmental procedure.

The students wear a neat uniform of *kharki*, drill with a turban or helmet, and they are regularly exercised in drill, most of the European and Eurasian students, however, preferring to join the Dehra Doon Corps of Mounted Infantry. When on tour in the forests on practical instruction, each has a small tent, with furniture of a camp-table, chair, and bedstead, and some of them amuse themselves occasionally in sport, one student last year distinguishing himself by carrying off the first prize for shooting in the province.

The forests attached to the School Circle consist of those of the Dehra Doon, Saharanpore, and Jaunsar Forest Divisions. The two former contain chiefly forests of the sál tree (*Shorea robusta*), the chief gregarious tree of India, and the most valuable timber, for building purposes, after teak. They occupy respectively the northern and southern slopes of the Siwalik Range, and are carefully managed as training forests. The Dehra Doon forests are now being worked under a working plan prepared by Mr. Fernandez, the Professor of Forestry. These forests had, till some twenty years ago, been very badly treated, so that at present the older portion of the stock consists chiefly of trees which are crooked and unsound, the good and sound ones having previously been all cut out to provide sleepers for the East Indian, and Sind, Punjab, and Delhi Railways. The present working plan provides for a temporary rotation of twenty years, during which (1) all the old, unsound, and crooked sál trees which can be cut without letting in too much light are removed; and (2) all trees of the less valuable kinds that are not required for shade are cut away. These operations have now been carried on for a few years with the most beneficial results, for the ground is being rapidly covered with good and straight saplings and coppice shoots of sál. The forest operations, the selection of the trees to be cut, and their marking and enumeration, are all done by the students themselves, so that in this way they obtain a valuable amount of practical experience.

The forests of Jaunsar lie on the hills of the outer Himalaya at an elevation of some 5000 to 10,000 feet, and consist chiefly of coniferous trees. The deodar cedar (*Cedrus Deodara*) is, of course, the most valuable of these; then come the pines, the "kail" (*Pinus excelsa*), which so often accompanies the deodar, and the "chir" (*Pinus longifolia*), which forms gregarious forest at the lower elevations. The silver and spruce firs (*Abies Webbiana* and *Smithiana*) also occur, as well as oaks (*Quercus incana*, *dilatata*, and *semicarpifolia*) and other temperate trees. These forests are also carefully treated under working plans, and in them the students of the School learn the management of coniferous forests, the extraction of timber by roads and slides, the planting of blanks in the forest, and the measures necessary for protection against fire and frost.

At the end of their course, and on obtaining their certificates, the students return to the provinces from which they were sent, qualified to carry out ordinary forest works in their own country; and some of them have already obtained promotion into the higher staff of the Department as the reward of their good work, industry, and energy.

The Forest School at Dehra Doon may thus be said to be doing an excellent work, a work which cannot fail to have the best possible effect in the country, and to show the truth of Sir Edwin Arnold's saying that "the Forest Conservancy carried out by the British 'Râj' is one of the greatest benefits to the peninsula."

Soon, perhaps, the extension of forest work will necessitate the establishment of other or branch establishments in Madras, Burmah, and elsewhere; but it is to Dehra Doon that all will look up as the pioneer of scientific forest teaching for the natives of our great dependency.

THE GIANT EARTHWORM OF GIPPSLAND.

THE recently-issued first part of the Transactions of the Royal Society of Victoria contains an elaborate essay (of which we have something to say elsewhere to-day) by Mr. Baldwin Spencer, the newly-appointed Professor of Zoology in the University of Melbourne, on the anatomy of the Giant Earthworm of Gippsland, the largest earthworm yet known. This worm, of which some examples attain to the extraordinary length of six feet, was first described by Prof. McCoy in 1879, and named *Megascolides australis*. It belongs to a peculiar Australian group, of which five species are now known. Mr. Spencer gives us the following general account of its habits:—

Of all the species of *Megascolides* yet known, this one seems to be the largest, and is apparently confined to Gippsland; it is, when found at all, somewhat abundant, and lives principally on the sloping sides of creeks. At times it is found beneath fallen logs, and may be turned out of the ground by the plough.

When first seeking it, we were somewhat puzzled by some of those who were evidently well acquainted with the worm assuring us that the entrance to its burrow was indicated by a distinct "casting"; whilst others, evidently equally well acquainted with the animal, were quite as positive in asserting that it never produced any "casting." Whilst searching, we found what I believe to be the explanation of the contradictory statements, and soon discovered that the surest test of the presence of the worm underground was a very distinct gurgling sound, made by the animal retreating in its burrow when the ground was stamped upon by the foot. When once heard, this gurgling sound is unmistakable, and we at once learnt to regard it as a sure sign of the worm's presence.

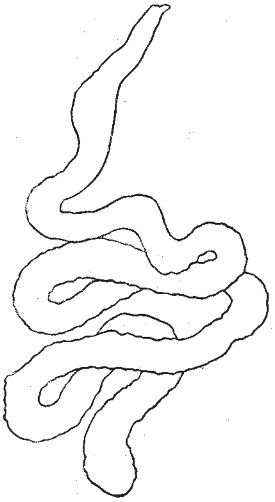
The worm very frequently lives in ground riddled by the holes of the land-crab, as it is popularly called; this animal has a small circular burrow leading down to a

©1889 Nature Publishing Group

chamber hollowed out underneath containing a pool of water, and through these chambers the worms' burrows frequently pass. The "crab" almost invariably has a large conical "casting" at the entrance to its hole, and may raise this to a height of even a foot and more; but the true worm-burrow never, so far as yet observed, has any "casting" at its entrance, and all trace of this is wanting where the crab-holes are absent. The very frequent association of the "crab" and worm leads to the idea that the latter forms a cast; but one of the most noticeable features of the ground, which is at times riddled with worm-burrows only, is the entire absence of "castings." What the worm does with the immense quantity of earth which it passes through its body I cannot at present say, and it must also be noticed that only on very rare occasions can any trace be detected of leaves dragged down into the burrows.

It is no easy matter to extract the worm without injury, owing to its length, the coiling of the burrow, the rapidity of movement which it possesses when underground, and its power of distending either the anterior or posterior ends of the body, or both.

Directly the burrow is laid bare, the worm is seen gliding rapidly away, often producing the curious gurgling sound as it passes through the slimy fluid always present in a burrow containing the living animal. Sooner than allow itself to be drawn out, it fixes, if held in the middle, both ends of its body by swelling them out till they are tightly jammed against the sides of the burrow; under these circumstances, pulling merely results in tearing the body. The worm has been described as brittle, but this term is most inapplicable, as its body is very soft, and capable of a great amount of extension before tearing. Its curious smell, when living, resembling somewhat that of creosote, has been already observed by Prof. McCoy, and, when dead, it is worse than ever, and very strong and characteristic; the body, in decaying, passes into an oily fluid, which, we were assured by one or two old natives of the district, is very good for rheumatism. Fowls refuse to touch the worm, living or dead.



Megascolides australis. Drawing of McCoy's figure ("Prodr. Zool. Vict.," i. pl. vii.).

When held in the hand, the worm, in contracting its body, throws out jets of a milky fluid from its dorsal pores to a height of several inches; if the burrow be examined carefully, its sides are seen to be very smooth, and coated over with a fluid exactly similar to that ejected from the pores. Whatever be the primary function of the fluid when within the body-cavity, there can be no doubt that it has the important and perhaps secondary function, when it has passed out of the body, of making the burrow walls smooth, moist, and slippery, and of thus enabling the animal to glide along with ease and speed.

The worm in its burrow moves rapidly by swelling up its anterior or posterior end, as the case may be, and then, using this as a fixed point, in doing which the setæ perhaps help, though to a minor extent, it strongly contracts the rest of its body. In the next movement, the end free in the first instance will be swollen out and used as a fixed point, from which expansion forwards can take place. These changes of motion follow each other so rapidly, that in the burrows the appearance of continuous gliding is given. Outside the burrow, when the whole body-surface is not in contact with the earth, the worm makes no attempt whatever to move, lying passively on the ground. Anyone who merely sees the beast removed from its burrow imagines it to be of a very sluggish temperament, and can form no idea of its active and rapid movements when underground.

So far as locomotion is concerned, its setæ seem to be of little or no use to it. The perichæte worms, on the contrary, when taken from the burrow, move along on the ground with remarkable speed, certainly using their setæ as aids to progression.

The burrows of the large worm measure ¾–1 inch in diameter; and in disused ones are often found (1) casts of the worms, or rather, what are probably the earthy contents of the alimentary canal, with clear indications marked upon them of the segments of the body; and (2) more rarely cocoons. The latter measure 1½–2 inches in length, vary from light yellow to dark brown in colour, according to their age, and contain only one embryo each, which I have at present only been able to obtain in a somewhat highly developed state.

The cocoon itself is somewhat thin, and made of a tough leathery material, with a very distinct stalk-like process at each end; it contains a milky fluid, closely similar to that found in the body-cavity of the worm.

It is interesting to note the fact that at the present time we know of three especially large kinds of earthworms; that, of these, one comes from South Africa, another from the southern parts of India and Ceylon, and the third from the south of Australia. We know as yet little about the distribution of earthworms, but the same laws which governed the distribution of other animals must also have governed theirs, and it is just possible that these great earthworms may be the lingering relics of a once widely-spread race of larger earthworms, whose representatives at the present day are only found, as occurs with other forms of life, in the southern parts of the large land-masses of the earth's surface. Possibly careful search will reveal the existence of a large earthworm in the southern parts of South America.

NOTES.

In reply to his letter in our columns on the 7th inst. (p. 341), Mr. Sclater has received applications from several unexceptionable candidates for the post of Naturalist to the Pilcomayo Expedition. Out of these, Captain Page has agreed to select Mr. Graham Kerr, of the University of Edinburgh, to accompany him. Mr. Kerr is most highly recommended by Prof. Balfour, Prof. Geikie, and Prof. Ewart as in every way suited for the work. He will leave England for Buenos Ayres about the beginning of June.

It has now been definitely arranged that the steamer *Hvidbjörnen* shall leave Copenhagen on March 15 for Greenland, in order to bring back the members of the Nansen Expedition. The vessel will, however, not be back in Copenhagen until the beginning of June. After a few days' sojourn in that city, Dr. Nansen will proceed direct to Bergen, and prepare a work on his expedition and its scientific results.

©1889 Nature Publishing Group